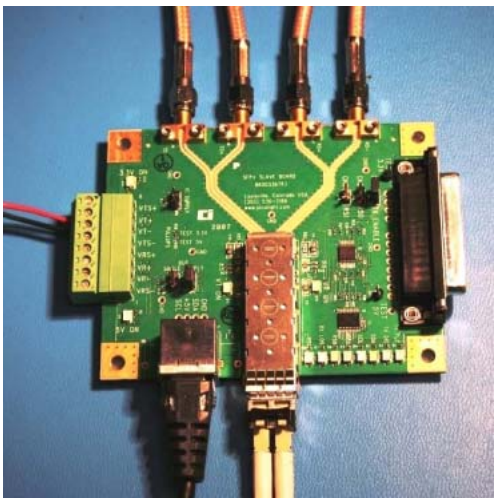
SFP+ Evaluation Board



PL-PP1-00-044-21 SFP+ Evaluation Board

Table of Contents

1 **Introduction** 1
2 **Equipment** 2
3 **Laser Safety Warning** 2
4 **Evaluation Board Overview** 3
5 **Description of Connectors and Jumpers** 4
6 **LED Status Indicators on the Evaluation Board** 10
7 **Typical Eye Diagrams** 12
8 **ESD Precautions** 13
9 **Optical Connector Care and Cleaning** 14
10 **References** 15
11 **Schematic** 17
12 **Component Placement Drawing** 18
13 **Card Dimension Drawing** 19

1 Introduction

This document describes how to use the JDSU SFP+ Evaluation Board PL-PP1-00-044-21 to characterize SFP and SFP+ products. Section 2 describes the equipment necessary to use the Evaluation Board for characterization. Section 3 contains laser safety warnings that should be considered when working with any Class 1 laser device. Section 4 describes a typical test set-up and power requirements for the JDSU SFP+ evaluation board. Section 5 describes connectors and jumpers on the board and Section 6 shows the LED status indicators. Section 7 illustrates typical eye diagrams from the Transmitter (TX) and Receiver (RX).

Section 8 explains ESD precautions that should be observed when working with any sensitive electro-optic device. Section 8 explains optical connector care and cleaning. The transceiver optical connector is a duplex LC connector. References to the standards applicable to SFP+ modules are provided in Section 10. A simplified schematic of the board appears in Section 11 in Figure 10 on page 17 and a Component placement drawing appears in Section 12 in Figure 11 on page 18. The dimensions of the board are supplied in Figure 12 on page 19.

High-speed performance testing can commence immediately after applying power to the board, inserting the SFP+ module under test, and connecting test equipment to the high-speed SMA connectors.

2 Equipment

The equipment required for setting up the JDSU SFP+ Evaluation Board for testing with SFP+ modules consists of the following items:

Required Equipment

- P/N PL-PP1-00-044-21 Evaluation Board
- 3.3 V Power supply and cable
- Optical loop-back and/or fiber jumpers or length of fiber with LC connectors
- Stimulus and analysis equipment (Pattern Generator, Error Detector, Digital Communications Analyzer with electrical and optical measurement capabilities for 8.5 to 10G applications)
- SFP+ Module. JDSU offers a number of SFP+ modules that can be ordered separately.

In addition, some optional equipment can be used to interrogate the device in order to read the SEID information and digital diagnostics.

Optional Equipment

- Philips[1] I²C interface (Host Adapter) to access the EEPROM and Digital Diagnostics. This is available from Micro Computer Control Corporation. See footnote 2 for additional information.
- JDSU SFP+ Graphical User Interface (GUI)[2]. This is available by request from JDSU through your normal sales channel.

3 Laser Safety Warning

The JDSU SFP+ optical transmitters are Class 1 Laser Products. JDSU SFP+ modules are eye-safe devices when operated within the limits of their respective specifications.

Operating this product in a manner inconsistent with intended usage and specification could result in hazardous radiation exposure.

CAUTION! Tampering with these laser-based products or operating these products outside the limits of their respective specifications may be considered an act of "manufacturing," and will require, under law, recertification of the modified product with the U.S. Food and Drug Administration.

1. © Philips Semiconductors I²C bus as defined in "THE I²C-BUS SPECIFICATION" version 2.1, January 2000. Available at: www.semiconductors.philips.com/acrobat_download/literature/9398/39340011.pdf
2. JDSU offers a GUI that can be used with this board for SFP, XFP, and SFP+ modules. An I-Port MIIC RS-232 to I²C Host Adaptor model MIIC-203, serial to I²C interface available from Micro Computer Control Corporation (http://www.mcc-us.com/), is required to communicate with SFP, SFP+, or XFP modules using the JDSU GUI. Contact JDSU for more information.

4 Evaluation Board Overview

The evaluation board has been designed to allow for the complete characterization and testing of all JDSU SFP+ optical transceivers operating up to 11.7 Gbps. This product is backward compatible with all SFP and SFP+ modules. A high performance microwave dielectric substrate, coplanar strip lines, SMA connectors rated to 18GHz, and high performance SFP+ card edge connectors are used in order to minimize the effect of the PCB and connectors on the measurement and characterization of the SFP+ module. Each board utilizes a JDSU cage with excellent EMI performance characteristics to allow the units to be directly installed. The line lengths have been designed to minimize channel timing skew. A DC power connector and jumpers are provided with each board. The evaluation board is pre-configured with zero ohm resistors installed across jumpers and is set-up for normal operating conditions and can be reconfigured at the users' discretion by removing the zero ohm resistors and using the shorting jumpers supplied. An optional I^2C interface is provided that is not required for testing.

4.1 Evaluation Board Set-up and Operation

The evaluation board is pre-configured for use with any SFP+ transceiver. The shorting jumpers are pre-installed. Many of the jumpers have 0 Ω resistors installed in parallel. The complimentary inputs of each data channel are common SMA jacks. An I^2C connector jack is installed for optional 2-wire serial communications with the SFP+ module.

4.1.1 Block Diagram of Typical Test System

Figure 1 below shows a typical block diagram of a test system showing an optical loopback for verifying functionality by testing the Bit Error Rate of the SFP+ Module. Other test set-ups are possible.

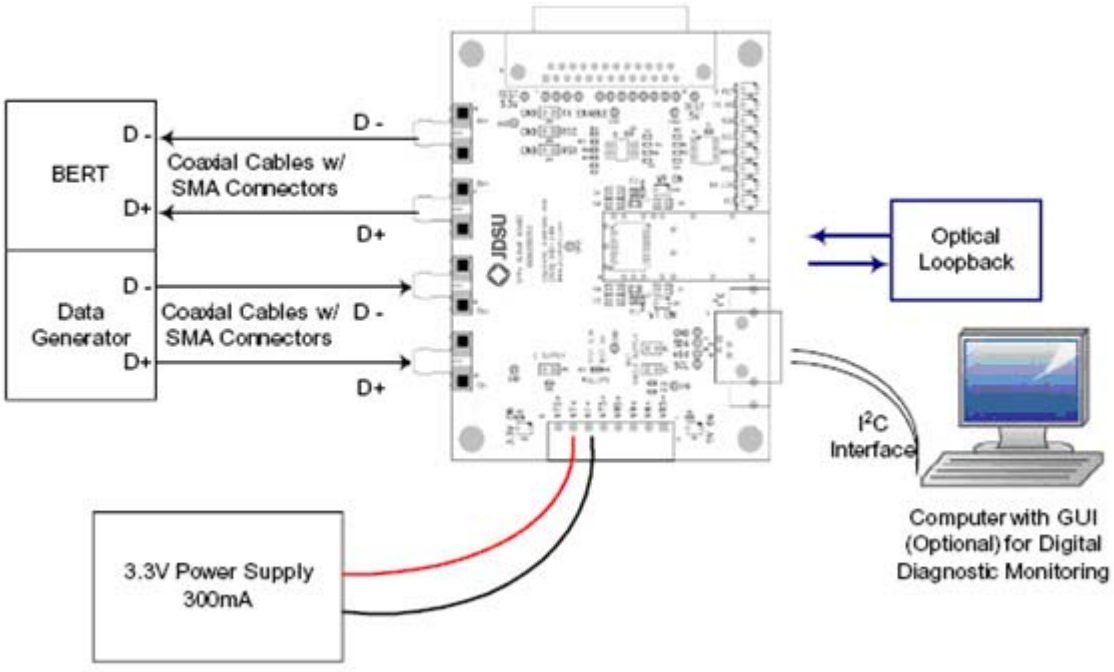


Figure 1: Block Diagram of a typical test set-up.

4.1.2 Power Supply

SFP+ devices are hot-pluggable and can be installed when the power is active. Set the power supply to achieve 3.3 VDC at the Transceiver. Verify that the transmitter is seeing 3.3 volts by checking the TX and RX voltage at the sense pins (VTS+/VTS- and VRS+/VRS- respectively) on the power supply connector (see Figure 2 below).

Note: Set the Current Limit to ~300 milliamps per evaluation board if using a common power supply. This should supply enough current for the TX, RX, and the Evaluation board over temperature.

- Maximum TX current is 110 mA
- Maximum RX current is 120 mA

4.1.3 Power Connections

The SFP+ Transceiver module requires separate power supplies for the TX and RX in accordance with the SFP+ MSA. TX power and RX power are applied at their respective 4-pin connectors. The Evaluation board is shipped with two 0 Ω resistors installed across the jumpers that allow the 2 power supplies to be connected together. If the user wants to power the TX and RX from individual power supplies then the 0 Ω resistors need to be removed. After the 0 Ω resistors are removed, either jumper JP1 or JP2 can be used to run both TX and RX from a single power supply.

5 Description of Connectors and Jumpers

Figure 2 below shows the location of the connectors and jumpers on the JDSU SFP+ Evaluation board.

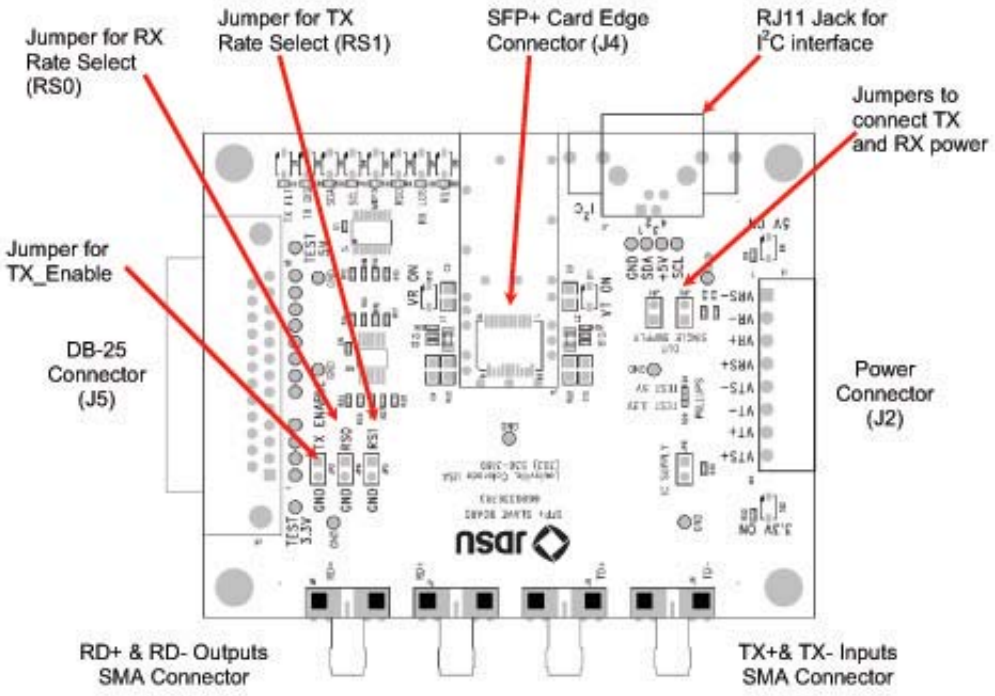


Figure 2: Connectors and Jumpers on JDSU's 10G SFP+ Evaluation Board.

5.1 Connectors

The evaluation board is pre-configured for use with any SFP+ transceiver. The shorting jumpers are pre-installed. Many of the jumpers have 0 Ω resistors installed in parallel. The complimentary inputs of each data channel are common SMA jacks. An I^2C connector jack is installed for optional 2-wire serial communications with the SFP+ module.

5.1.1 J1: 4-Pin Connector for 2-Wire Serial Interface (I^2C)

The I^2C or MOD_DEF 2-wire serial interface is optional and is only required if it is desired to view the Serial ID information or to access the digital diagnostics. JDSU offers a GUI that requires a particular serial to I^2C converter to interface with the module under test. JDSU's GUI requires a MCC (Micro Computer Control, www.mcc-us.com) RS-232 to I^2C adapter model MIIC-203. Connection to the evaluation board as described below requires simple modification of the cable supplied with the serial-to-I^2C adapter. The pull-up on the MMIC module can be set to either the "ON" or "OFF" position.

- Pin 1 = GND (LED D5), is grounded by the module to indicate that the module is present. This pin is called MOD-ABS in SFF 8431. (aka MOD-DEF0)
- Pin 2 = SDA (LED D3) is the data line of the serial interface. (aka MOD-DEF2)
- Pin 3 = +5V
- Pin 4 = SCL (LED D4) is the clock line of the serial interface. (aka MOD-DEF1)

5.1.2 J2: Power Connector

- $V_{CC}T$; 4-Pin connector for TX Power Supply (3.3 V) labeled "VT+" (LED D11)
  - Sense terminals are labeled VTS+ and VT-
- $V_{CC}R$; 4-Pin connector for RX Power Supply (3.3 V) labeled "VR+" (LED D10)
  - Sense terminals are labeled VR+ and VR-.

5.1.3 J3: SFP+ Cage

JDSU offers a line of SFP+ cages with enhanced EMI performance for use at high frequencies. These cages are shown in Table 1 on next page. This board takes a single solder-down or press-fit cage. 1x2 and 1x4 cages are shown for completeness.

Table 1 JDSU EMI-Enhanced Cages

Part Number	Pin Length	Description	Minimum PCB Thickness	
			Single-Sided	Belly-to-Belly
Solder-Down Cages				
PL-KP1-00-000-06 [1]	.114" (2.9 mm)	Solder-down cage for standard applications, .062" minimum PCB	.062" (1.8 mm)	NA
Press-Fit Cages				
PL-KP2-00-000-06 [1]	.110" (2.8 mm)	Press-fit, for standard PCB	.062" (1.8 mm)	.125" (3.2 mm)
PL-KP2-00-000-16 [1]	.085" (2.2 mm)	Press-fit, for 090" PCB belly-to-belly	.062" (1.8 mm)	.090" (2.3 mm)
PL-KP2-00-000-07 [1, 2]	.110" (2.8 mm)	Press-fit, Tongue-less version of the -06	.062" (1.8 mm)	.125" (3.2 mm)
PL-KP2-00-000-17 [1, 2]	0 .085" (2.2 mm)	Press-fit, Tongue-less version of -16, for .090" PCB belly-to-belly applications	.062" (1.8 mm)	.090" (2.3 mm)
PL-KP2-00-000-26 [1]	.110" (2.8 mm)	Press-fit, PCI-compliant (1° tilt) for .125" PCB belly-to-belly applications	.062" (1.8 mm)	.125" (3.2 mm)
1x2 and 1x4 Press-Fit Cages				
PL-KP2-21-000-21 [1]	.085" (2.2 mm)	Press-fit, 1x2 side-by-side, cage for 4G+ applications	.062" (1.8 mm)	.090" (2.3 mm)
PL-KP2-21-000-11 [1]	.110" (2.8 mm)	Press-fit, 1x2 side-by-side, with Light pipes, cage for 4G+ applications	.062" (1.8 mm)	.090" (2.3 mm)
PL-KP2-41-000-21 [1]	.110" (2.8 mm)	Press-fit, 1x4 side-by-side, cage for 4G+ applications	.062" (1.8 mm)	.090" (2.3 mm)

Note: All cages are RoHS-compliant.

1. These cages have tin-plated beryllium copper EMI fingers that are spot welded in place and are RoHS-compliant
2. These cages are compatible with SFP+ modules that use a retracting latch mechanism such as JDSU and many other manufacturers use. These cages may not be compatible with some vendors' SFP+ modules, and in these cases the SFP+ module will not engage the latch.

Some examples of the cages are shown in Figure 3, Figure 4, and Figure 5 on page 7.

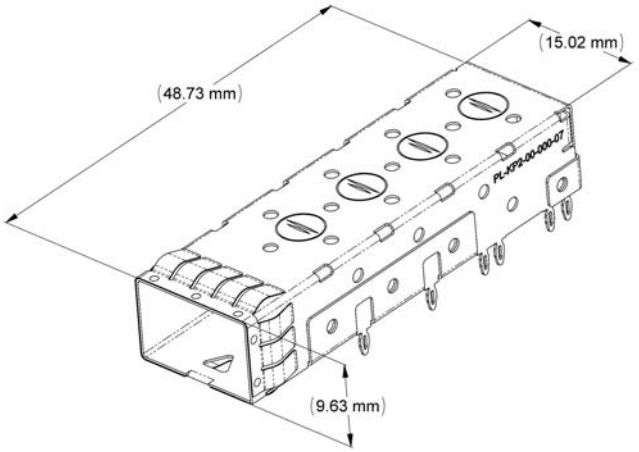


Figure 3: JDSU EMI-Enhanced Press-fit Cage

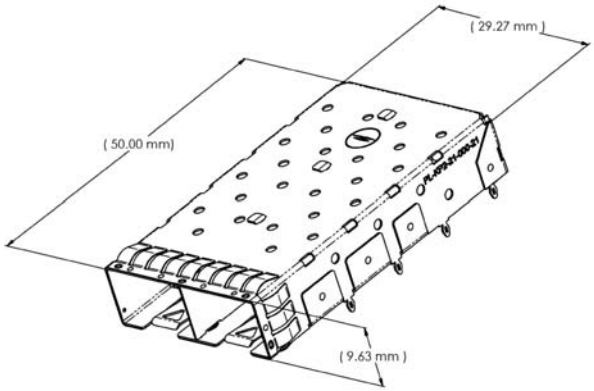


Figure 4: JDSU EMI-Enhanced Press-fit 1x2 Cage

Figure 5: JDSU EMI-Enhanced Press-fit 1x2 Cage with light pipes

5.1.4 J4: SFP+ Connector

Some SFP edge card connectors may not be compatible with higher speed SFP+ applications. SFP+ connectors for 8.5 and 10 G applications are produced by Tyco Electronics[3] and Molex[4] . The Tyco part number is 1888247-1. The Tyco part is a distinctive off-white color enabling it to be easily distinguished from other connectors. Molex produces two parts with different electrical plating thicknesses. Part number 74441-0001 has 15 micro-inch gold plating, and is most common. Part number 74441-0010 has 30 micro-inch gold plating. See SFF-8083 for more information about the SFP+ card edge connector.

5.1.4.1 SFP+ Connector Pin Definitions

Figure 6 shows the Pin Definitions for SFP+ based on a draft of SFF-8431 Revision 2.1. Notice that pins 7 and 9 (RS0 and RS1, respectively) are the rate-select pins that control the rate-select functionality. These pins are defined in SFF 8431 as logic high for bit rates greater than 4.25Gbps and logic low for 4.25 Gbps and below. RS0 is designated for the RX, and RS1 is designated for the TX. JDSU modules do not currently use RS1 as the TX is in specification for all the bit rates from 2 to 8 Gbps without requiring a TX rate select. In addition, non-rate select modules are not affected by signals on these pins. Internal 30 kΩ pull-down resistors connect RS0 and RS1 to ground in all JDSU SFP+ modules.

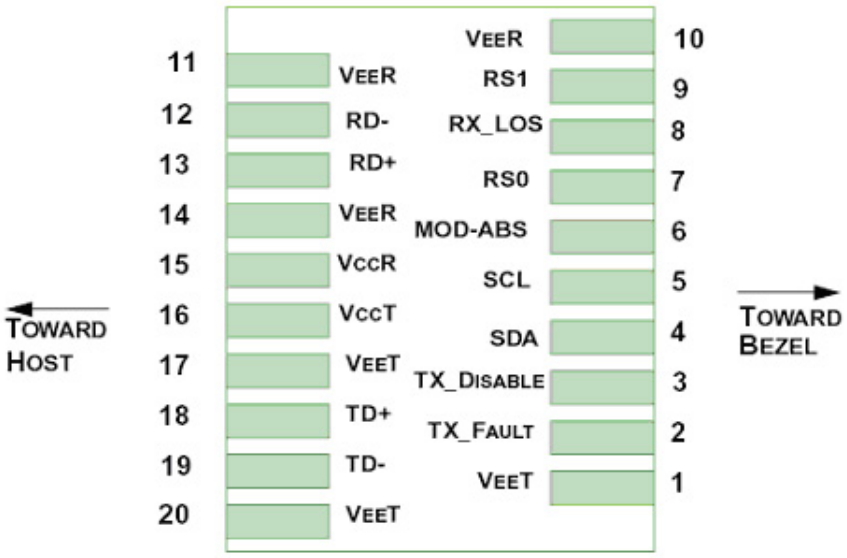


Figure 6: Host PCB SFP+ pinout top view as defined in SFF-8431 R2.1

5.1.5 J5: DB-25 Connector

Connector J5 is a DB-25 connector (jack) that provides access to many of the modules monitor and control functions. Table 2 on page 9 provides a list of the pins with a description of each pin's function.

3. Tyco Electronics, www.tycoelectronics.com 1-887-800-7245
4. Molex http://www.molex.com/ 1-800-78MOLEX

Table 2 Description of pins on DB-25 Connector J5

Pin	Label	Description
1	VCCR	Provides access to VCCR, can be monitored or applied via this pin
2	IR+	Provides access to monitor Receiver current (see schematic)
3	VCCT	Provides access to VCCT, can be monitored or applied via this pin
4	IT+	Provides access to monitor Transmitter current (see schematic)
5		Not Used
6	TX_FLT	Monitor transmitter fault condition
7	TX_DIS	Monitor transmitter disable condition
8	MODDEF2	Monitor or apply SDA
9	MODDEF1	Monitor or apply SCL
10	MODEF0	Monitor MOD_ABS
11	Rate_SEL0	Monitor or apply RS0
12	LOS_FP	Monitor receiver loss of signal
13	RATE_SEL1	Monitor or apply RS1
14	TEST_3.3V	Monitor or apply 3.3V test voltage
15-24	GND	These pins are grounded.
25	TEST_5V	Monitor or apply 5V Test voltage

5.1.6 J6-J9: Electrical High-Speed Interface TX/RX (SMA connectors)

- J6: RD- (Receiver Data Complement)
- J7: RD+ (Receiver Data)
- J8: TD+ (Transmitter Data)
- J9: TD- (Transmitter Data Complement)

5.2 Jumpers

5.2.1 Power Supply JP1, JP2

- VccT; 4-Pin connector for TX Power Supply (3.3 V) labeled “VT+” (LED D11)
  - Sense terminals are labeled VTS+ and VTS-
- VccR; 4-Pin connector for RX Power Supply (3.3 V) labeled “VR+” (LED D10)
  - Sense terminals are labeled VRS+ and VRS-.
- JP1, JP2: Jumper to connect RX and TX Power supply (optional)
  - The board is shipped with R18 and R19 populated with 0 Ω resistors. To separate the TX and RX power supplies the resistors need to be removed.
  - Once the 0 Ω resistors are removed, shorting either jumper will connect VT+ to VR+.

5.2.2 SFP+ Control Jumpers JP3, JP4 and JP5

- JP3: TX_ENABLE; If this jumper is left open, the TX is disabled. The state of this pin is indicated by D2.
- JP4: Rate_Select_0 (RS0); Not all SFP+ modules offer rate select functionality. This hardware setting only affects modules with RX Rate Select (RS0) functionality and when in the lower logic state, can be overridden by firmware. If this jumper is left open, then RX operation is optimized for maximum data rate in SFP+ modules with rate select functionality. If this jumper is shorted, RX Rate select is asserted and the RX operation in SFP+ modules with rate select functionality is optimized for lower data rates per SFF-8079, INF-8074i and SFF-8472. The state of this pin is indicated by D6.
- JP5: Rate_Select_1 (RS1); Not all SFP+ modules offer rate select functionality. This hardware setting only affects modules with TX Rate Select (RS1) functionality and when in the lower logic state, can be overridden by firmware. If this jumper is left open, then TX operation is optimized for maximum data rate in SFP+ modules with rate select functionality. If this jumper is shorted, TX Rate select is asserted and the TX operation in SFP+ modules with rate select functionality is optimized for lower data rates per SFF-8079, INF-8074i and SFF-8472. The state of this pin is indicated by LED D8.

6 LED Status Indicators on the Evaluation Board

A number of LEDs on the board indicate the status of various parameters. Table 3 below provides a list of the LEDs and their function. The location of each LED on the board is shown in Figure 7, on page 11. Each LED is described in more detail in the following section.

Table 3 LED Status Indicators

N	Label	Description	Color	Condition indicated when illuminated
1	TX FLT	TX_FAULT	RED	Transmitter Fault condition exists
2	TX DIS	TX_DISABLE	RED	Transmitter is disabled
3	SDA	DATA	YELLOW	Data is active
4	SCL	CLOCK	YELLOW	Clock is active
5	MDF0	MOD-ABS	YELLOW	Module is absent
6	RS0	RS0	GREEN	RX Rate Select is asserted
7	RX LOS	RX_LOS	RED	No Data signal at RX
8	RS1	RS1	GREEN	TX Rate Select is asserted
9	5V ON	5V Power	GREEN	5V power applied
10	VR ON	VccR	GREEN	Receiver power supply is on
11	VT ON	VccT	GREEN	Transmitter power supply is on
12	3.3V ON	3.3V Power	GREEN	3.3V power applied

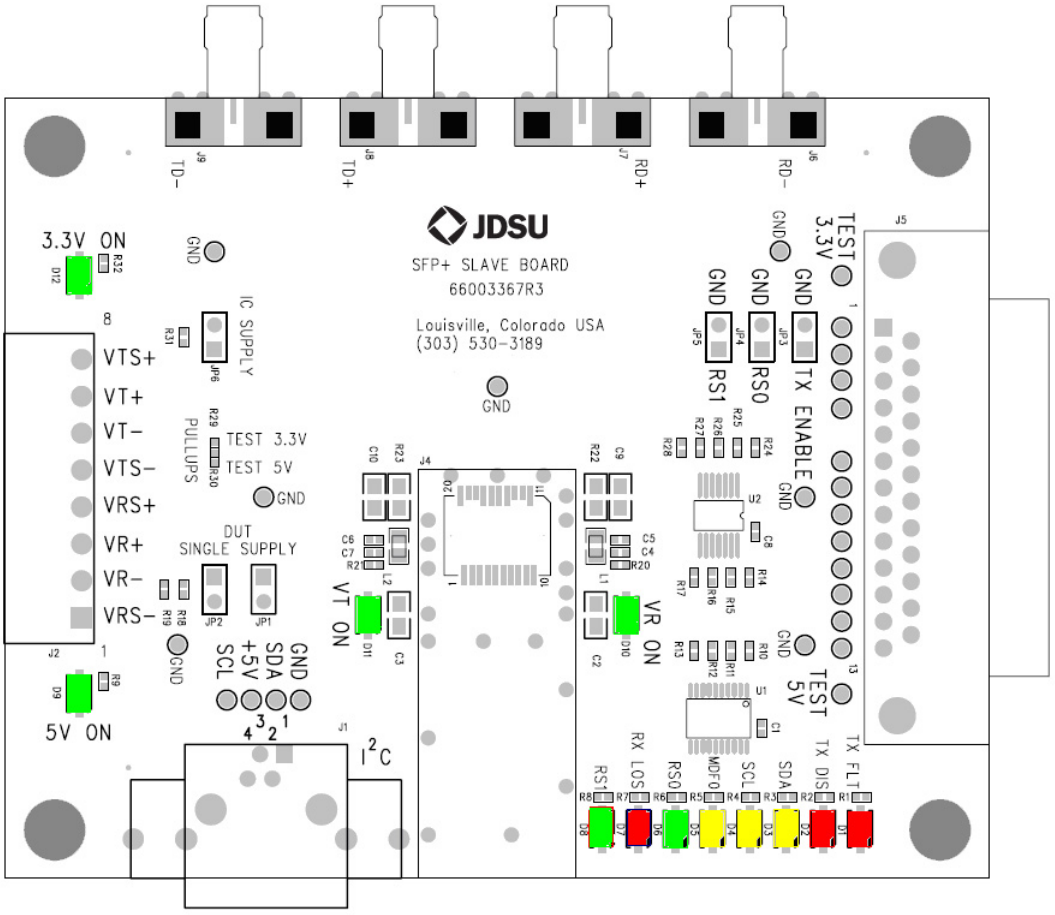


Figure 7: Location of LED Indicators on the JDSU SFP+ Evaluation Board

6.1 Power Supply

Two (2) LEDs indicate RX power and TX power have been applied.

- VR+: $V_{CC}R$; Indicates power has been applied to the RX (LED D10 Green)
- VT+: $V_{CC}T$; Indicates power has been applied to the TX (LED D11 Green)

6.2 I²C or MOD_DEF Communication

Three (3) LEDs indicate MODDEF or I²C communications

- MDF0; MOD-ABS Same as MOD_DEF0, this LED (D5 Yellow) is OFF when the module is present.
- SCL; Same as MOD_DEF1, this LED (D4 Yellow) represents the clock signal and will blink perceptibly during I²C communications.
- SDA; Same as MOD_DEF2, this LED (D3 Yellow) represents the data signal and will blink perceptibly during I²C communications.

6.3 SFP+ Monitor and Control

Four (4) LEDs indicate various module parameters.

- RXLOS: RX_LOS; Indicates Loss of Signal at the RX when illuminated. (LED D6 RED)
- RATE_SELECT: The LEDs do not necessarily reflect the rate select setting of the SFP+ module because some modules can be controlled by firmware. The rate select state of the module is controlled by the "OR" of the hardware state and the firmware state.
  - RX RATE_SELECT (RS0); Indicates status of hardware setting of RX Rate Select. LED ON indicates that the hardware configuration for RX Rate Select is set to high bandwidth operation. (LED D6 Green) SFP or SFP+ modules that do not support RX rate select functionality will not respond to a signal on pin 7.
  - TX RATE_SELECT (RS1); Indicates status of hardware setting of TX Rate Select. LED ON indicates that the hardware configuration for TX Rate Select is set to high bandwidth operation. (LED D8 Green SFP or SFP+ modules that do not support TX rate select functionality will not respond to a signal on pin 9.
- TX DIS: TX_Disable; LED ON indicates that the TX has been disabled via the hardware setting on jumper JP2. (LED D2 RED) If the LED is ON it indicates that the module has been disabled. If the LED is off, it does not reflect the firmware setting when Soft_TX_Disable is activated.
- TX FLT: TX_Fault; LED ON indicates a TX Fault condition exists. (LED D1 RED)

7 Typical Eye Diagrams

Figure 8 below shows a typical TX optical eye and a typical RX electrical eye. Figure 9 on page 13 shows an additional TX Optical eye taken from a JDSU 10G SFP+ module with a 1310nm VCSEL.

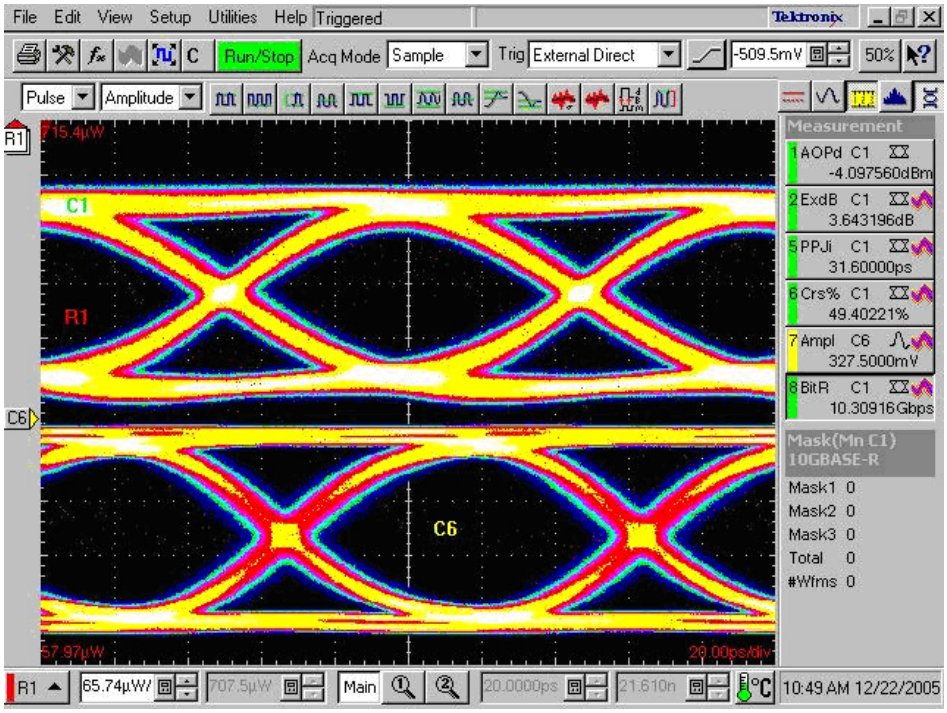


Figure 8: TX (top trace) and RX (bottom trace) eyes from JDSU's 10G SFP+ module.

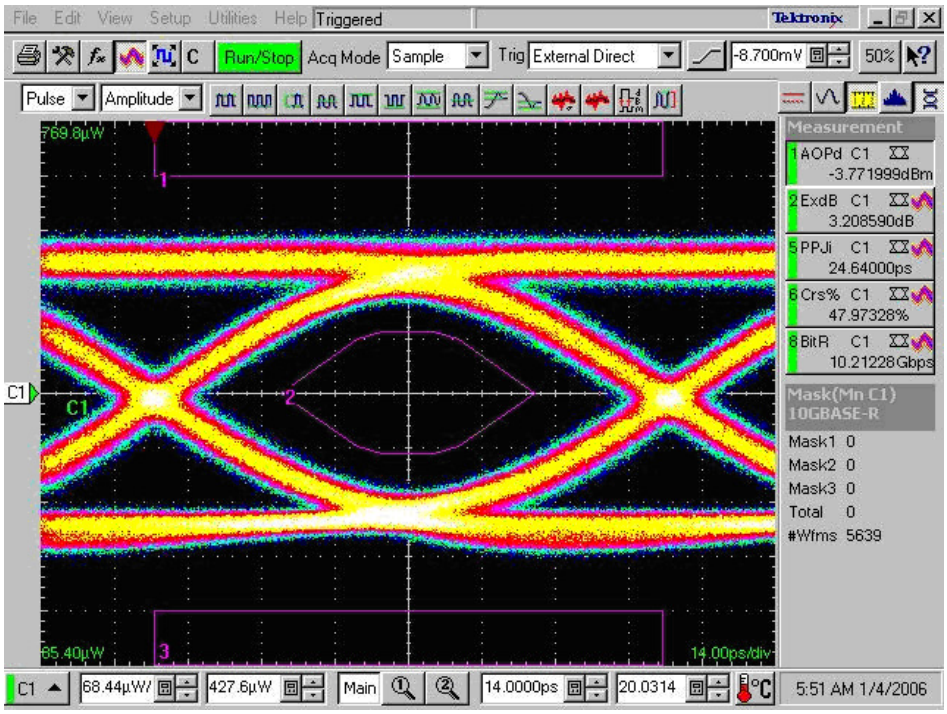


Figure 9: Transmitter Eye from JDSU's 1310nm 10G SFP+ with 10GbE Mask.

8 ESD Precautions

Normal ESD precautions are required during the handling of this equipment. The transceivers and evaluation boards are shipped in ESD protective packaging. They should be removed from the packaging and otherwise handled in an ESD protected environment utilizing standard grounded benches, floor mats, and wrist straps.

The following precautions should be observed at all times when using static-sensitive boards and devices.

8.1 Electrostatic Discharge (ESD)

When handling electrostatic sensitive devices make certain that the environment is protected against electrostatic discharge. Operators should wear anti-static clothing. Containers and other objects that come into direct contact with devices should be made of anti-static materials and should be grounded to earth via a 0.5 MΩ to 1.0 MΩ protective resistor. Please follow the precautions described below.

8.2 Work Environment

When humidity in the working environment decreases, the human body and other insulators can easily become charged with static electricity due to friction. Maintain the recommended humidity of 40% to 60% in the work environment, while also taking into account the fact that moisture-proof-packed products may absorb moisture after unpacking.

Be sure that all equipment, jigs and tools in the working area are grounded to earth.

Place a conductive mat over the floor of the work area, or take other appropriate measures, so that the floor surface is protected against static electricity and is grounded to earth. The surface resistivity should be 10^4 to 10^8 Ω /sq and the resistance between surface and ground, 7.5 x 10^5 to 10^8 Ω

Cover the workbench surface with a conductive mat with a surface resistivity of 10^4 to 10^8 Ω/sq, for a resistance between surface and ground of 7.5 x 10^5 to 10^8 Ω. The purpose of this is to disperse static electricity on the surface through resistive components and ground it to earth. Workbench surfaces must not be constructed of low-resistance metallic materials that allow rapid static discharge when a charged device touches them directly.

Note: Do not operate electronic circuits in direct contact with conductive mats.

8.3 Operating Environment

- Operators must wear anti-static clothing and conductive shoes (or a leg or heel strap).
- Operators must wear a wrist strap grounded to earth via a resistor of about 1MΩ.
- Soldering irons must be grounded from iron tip to earth, and must be used only at low voltages (6V to 24V).
- If tweezers are likely to touch device terminals, use anti-static tweezers. Avoid metallic tweezers. If a charged device touches a low-resistance tool, rapid discharge can occur. When using vacuum tweezers, attach a conductive chuck to the tip and connect it to a dedicated ground used especially for anti-static purposes (suggested resistance value: 10^4 to 10^8 Ω).
- Do not place devices or their containers near sources of strong electrical fields (such as near a CRT).

When storing printed circuit boards which have ESD–sensitive devices mounted on them, use a board container or bag that is protected against static discharge. To avoid the occurrence of static charge or discharge due to friction, keep the boards separate from one another and do not stack them directly on top of one another.

- Ensure that any articles that are brought to any location where the level of static electricity must be closely controlled are constructed of anti-static materials.
- In cases where the human body comes in direct contact with a device, be sure to wear anti-static finger covers or gloves (suggested resistance value: 10^8 Ω or less).
- Equipment safety covers installed near devices should have resistance ratings of 10^9 Ω or less.
- If a wrist strap cannot be used for some reason, and there is a possibility of imparting friction to devices, use an ionizer.

9 Optical Connector Care and Cleaning

While not intended to be a complete guide, the following steps are given as a reference for optical fiber connector cleaning. JDSU recommends using either a dry cloth cleaning system, or lint-free wipes/swabs moistened with 99% pure isopropyl alcohol followed by 3 short blasts of canned air. All cleaning materials have been shown to cause scratches on fiber end-faces and optical surfaces and care should be taken to handle these surfaces gently. NEVER clean the fiber end-face with a dry tissue.

Process plug

The JDSU SFP+ transceivers are supplied with a process plug. This plug protects the transmitter and receiver's optics during standard manufacturing processes by preventing contamination from dust or other airborne particles. It is recommended that the process plugs remain in the transmitter and receiver whenever an optical fiber connector is not inserted. Process plugs should be cleaned carefully before reinsertion into the module.

9.1 Cleaning Optical Connectors with Wipes, Swabs and Isopropyl Alcohol

The following items are required:

- Canned Air (Clean, dry, oil free compressed air)
- Industrial grade 99% pure isopropyl alcohol (Commercially available isopropyl alcohol is not recommended as it may be diluted with water and a light mineral oil and may leave a residue.)
- Lint free wipes, such as Kimwipes®
- Lint-free swabs

9.1.1 Instructions for Fiber Connector End-face Cleaning

Step 1 Fold a clean soft, lint-free wipe such as Kimwipes® several times to get a pad of 6 to 8 layers of material.

Step 2 Remove the protective cap on the optical fiber cable connector.

Step 3 Dampen (but do not soak) a corner of the wipe with alcohol using the alcohol dispenser.

Step 4 Firmly but gently press the tip of the optical connector into the alcohol-moistened area of the wipe. Slide the connector back and forth on the wipe. Repeat this step three times, using a clean alcohol-moistened area each time.

Step 5 Discard the used wipe.

Step 6 A couple of short blasts of clean, dry, oil-free compressed air should be used to remove any tissue fragments that may have been deposited on the connector end-face during cleaning.

Inspect the connector end-face. If it is still dirty, repeat the cleaning procedure

9.1.2 Instructions for Cleaning the Optical Connector on the TRX Module

The optical connector on the TRX modules should only require cleaning with a couple of short blasts of clean, dry, oil-free compressed air. In rare cases when foreign material comes in contact with the optical interface of the TRX module, lint-free swabs that have been lightly moistened with industrial grade isopropyl alcohol can be used to clean the optical interface by gently wiping them across the surface. This should be followed by a couple of short blasts of clean, dry, oil-free compressed air.

9.2 Cleaning Optical Connectors with Dry Cloth Cleaning Kits

Many brands of dry cloth cleaning kits are commercially available including the NTT-AT Connector Cleaning Kit, Hellermann/Tyton Fiberclean, Specialized Products Company's UCC-700 Universal Connector Cleaner, and others. Refer to the manufacturer's instructions.

10 References

10.1 Applicable Standards

Table 4 on the next page indicates which standards apply to the SFP+ modules.

Table 4 Applicable Standards Related to SFP+ Modules

Signaling Rate	High-Speed Electrical	Low-Speed Electrical	Optical	Management	Mechanicals
2 Gbps	FC-PI-2	SFP+ MSA	FC-PI-2	SFF-8472	SFP+ MSA
4 Gbps	FC-PI-2	SFP+ MSA	FC-PI-2	SFF-8472	IPF & SFP+ MSA
8 Gbps	FC-PI-4	SFP+	FC-PI-4	SFF-8472	IPF
10 Gbps	SFP+	SFP+	10GbE	SFF-8472	IPF

SFP MSA	INF-8074i SFP (Small Form-Factor Pluggable) Transceiver
SFF-8472	Specification for Diagnostic Monitoring Interface for Optical Transceivers Rev 9.5, June 1, 2004
IPF	SFF-8432, Improved Pluggable Form-factor; mechanics
SFP+	SFF-8431, Low speed and management electrical interfaces for all SFP+ modules including the high speed electrical interfaces for 10GBE, both linear and limiting
10GbE	802.3ae (SR/LR/ER) and 802.3aq (LRM)
8G FC	Fibre Channel Physical Interface 4 (FC-PI-4) (Current draft is Rev. 6.01)
Connector	SFF-8083 defines the card edge electrical connector to be used with SFP+

10.2 I²C Interface

- Phillips I²C Bus Interface: http://www.semiconductors.philips.com/i2c

11 Schematic

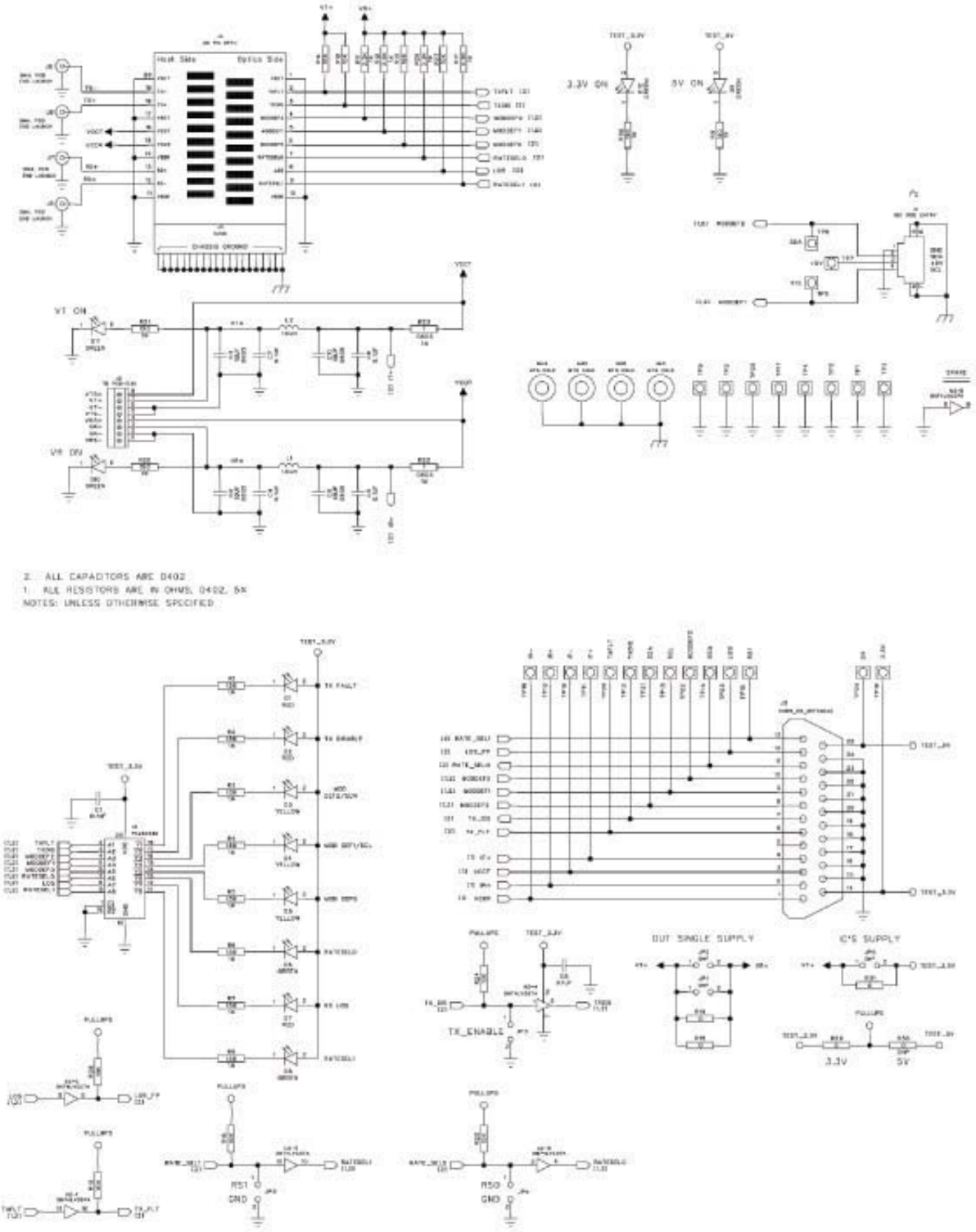


Figure 10: Evaluation Board Schematic

12 Component Placement Drawing

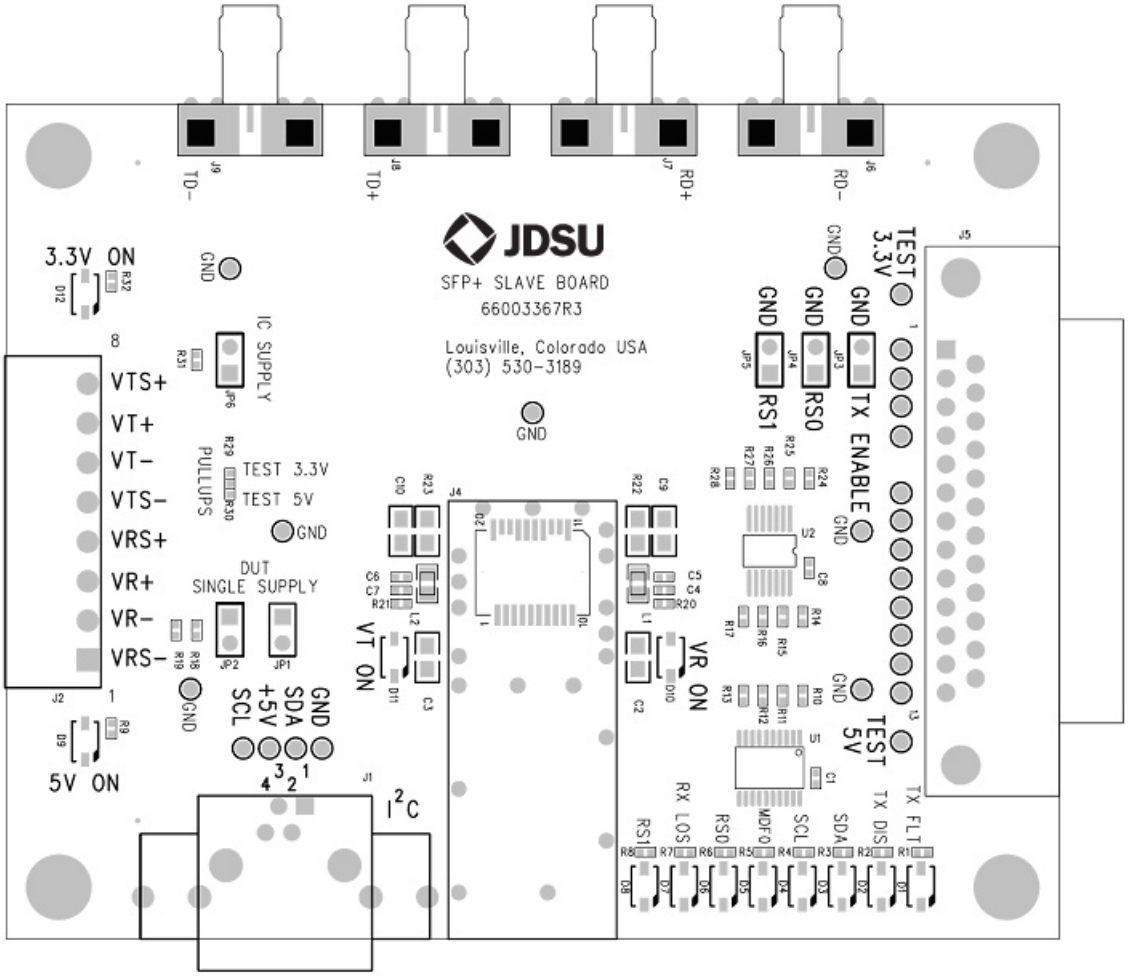


Figure 11: Component Placement Drawing

13 Card Dimension Drawing

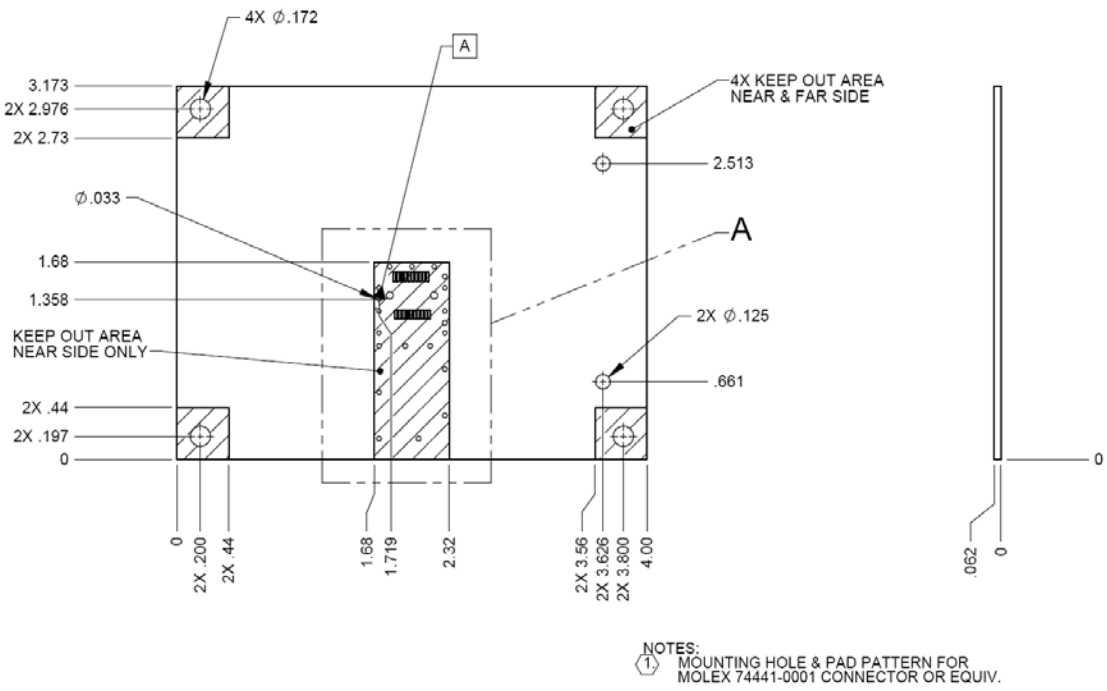


Figure 12: Evaluation Board Dimensions

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